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The inversion of (3) was so chosen that the original sphere became a plane, thus making the solution depend upon the simpler problem of finding the orthogonal trajectory of a family of plane curves.

Also solved by G. B. M. Zerr.

CALCULUS.

81. Proposed by J. OWEN MAHONEY, M. Sc., Dallas, Texas.

$$\text{Solve, } y^2 \frac{d^2 y}{dx^2} + a \frac{dy}{dx} = bx.$$

Solution by G. B. M. ZERR, A. M., Ph. D., Persons, W. Va.

$$\text{Let } y = A + Bx + Cx^2 + Dx^3 + Ex^4 + \dots$$

$$dy/dx = B + 2Cx + 3Dx^2 + 4Ex^3 + 55Fx^4 + \dots$$

$$d^2 y/dx^2 = 2C + 6Dx + 12Ex^2 + 20Fx^3 + 30Gx^4 + \dots$$

$$y^2 = A^2 + B^2 x^2 + C^2 x^4 + 2ABx + 2ACx^2 + 2ADx^3 + 2AEx^4 + 2BCx^3 + 2BDx^4 + \dots$$

$$\therefore y^2 (d^2 y/dx^2) + a(dy/dx)^2 = bx \text{ gives us}$$

$$bx = \begin{array}{c|c|c|c|c|c} 2A^2 C & +6A^2 D & x+12A^3 E & x^2+20A^2 F & x^3+30A^2 G & x^4+\dots \\ +aB^2 & +4ABC & +2B^2 C & +6B^2 D & +12B^2 E & \\ & +4aBC & +12ABD & +24ABE & +2C^3 & \\ & & +4AC^2 & +16ACD & +40ABF & \\ & & +4aC^2 & +4BC^2 & +28ACE & \\ & & +6aBD & +8aBE & +12AD^2 & \\ & & & +12aCD & +16BCD & \\ & & & & +9aD^2 & \\ & & & & +10aBF & \\ & & & & +16aCE & \end{array}$$

Equating like powers of x we get

$$C = -\frac{aB^2}{2A^2}, \quad D = \frac{2A^2 b + 4aAB^3 + 4a^2 B^3}{12A^4},$$

$$E = \frac{aB^4 [A^2 - (A+a)(4A+3a)] - abA^2 B - 2bA^3 B}{12A^6}.$$

$$\begin{aligned} \therefore y = A + Bx - \frac{aB^2}{2A^2} x^2 + \frac{2A^2 b + 4aAB^3 + 4a^2 B^3}{12A^4} x^3 \\ + \frac{aB^4 [A^2 - (A+a)(4A+3a)] - abA^2 B - 2bA^3 B}{12A^6} x^4 + \dots \end{aligned}$$

where A and B are constants of integration.

This solution does not give a unique result.